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The endowment of research is demanded now as never before. The development of technical education, the intellectual training of men to fit them for positions formerly held by mere tyros, has changed the material conditions in America. The surveyor has disappeared—none but a civil engineer is trusted to lay out even town lots; the founder at an iron furnace is no longer merely a graduate of the casting house—he must be a graduate in metallurgy; the manufacturer of paints cannot entrust his factory to any but a chemist of recognized standing; no graduate from the pick is placed in charge of mines—a mining engineer alone can gain confidence; and so everywhere. With the will to utilize the results of science there has come an intensity of competition in which victory belongs only to the best equipped. The profit awaiting successful inventors is greater than ever and the anxious readiness to apply scientific discoveries is shown by the daily records. The Röntgen rays were seized at once and efforts made to find profitable application; the properties of zirconia and other earths interested inventors as soon as they were announced; the possibility of telegraphing without wires incited inventors everywhere as soon as the principle was discovered.

Nature's secrets are still unknown and the field for investigation is as broad as ever. We are only on the threshold of discovery and the coming century will disclose wonders far beyond any yet disclosed. The atmosphere, studied by hundreds of chemists and physicists for a full century, proved for Rayleigh and Ramsay an unexplored field within this decade. We know nothing yet. We have gathered a few large pebbles from the shore, but the mass of sands is yet to be explored.

And now the moral has been drawn. The pointing is simple. If America, which, more than other nations, has

profited by science, is to retain her place, Americans must encourage, even urge research; must strengthen her scientific societies and her universities, that under the new and more complicated conditions her scientific men and her inventors may place and keep her in the front rank of nations.

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RECENT PROGRESS IN MALACOLOGY.

THE literature of the Rudistes in America is very scant. One of the important contributions to it that has yet appeared is due to Professor R. P. Whitfield,* who has recently described an interesting collection from the Cretaceous rocks of Jamaica. This comprises six species of *Radiolites*, one of *Caprina*, two of *Caprinella* and one of *Caprinula*. The descriptions are accompanied by excellent photo-engravings of the specimens, one of which reaches eighteen inches in diameter. In the same Bulletin† Professor Whitfield prints some extremely interesting observations on the problematical organism called *Barrettia*, first described by Woodward in 1862, from the Cretaceous limestones of Jamaica. The specimens which form the subject of the present article include, beside the original type of the genus, two new species which, with the others, are lavishly illustrated. *Barrettia* was first regarded as one of the Rudistæ though certain features analogous to coral structure were pointed out by Woodward. Whitfield's observations, though not claimed as decisive, lead in the latter direction and indicate that this singular fossil is probably related to the operculate corals, though from many points of view widely separated from any of the corals hitherto recognized as such. It may be mentioned that the

* Bull. Am. Mus. Nat. Hist. IX., Art. XI., pp. 185-196, Pl. VI.-XXII., New York, 1897.

† Op. cit., Art. XX., pp. 233-246, Pl. XXVII.-XXXVIII.

peripheral structure of *Barrettia* strongly recalls that of some of the parasitic balani.

The year-book for 1896 of the Museum at Bergen, Norway, where so much excellent zoological work has been done in past years, by Danielsen, Nansen and others, has recently been distributed. The leading paper in this volume* is an investigation of the eyes of *Pecten* and *Lima* by K. E. Schreiner. Anyone who has ever examined a living scallop has been struck by the jewel-like beauty of the brilliantly colored eyes on the edge of the mantle. These are shown by Schreiner to possess a rather high type of organization, the details of which are carefully worked out and fully illustrated. A considerable number of species was examined. On the other hand, the allied genus *Lima*, represented by the gigantic deep-water *L. excavata*, has a very low type of visual organ, a mere open pit lined with pigmented epithelium, much like the analogous organs in *Patella*. In the same volume† James A. Grieg contributes an article on the Vestland mollusks, including several nudibranchs new to the region. Anatomical details in regard to a variety of *Tritonia plebeia* are recorded. Felix Bernard has continued the excellent researches on the development of the hinge-teeth in bivalves, to which we have already called attention in an earlier number of this JOURNAL. In a recent number of the *Journal de Conchyliologie* ‡ he considers a small group of small bivalves for which is proposed the name Condylocardia, and with which he would unite the genera *Carditella* and *Carditopsis* in a special family Condylardiidæ. These shells he considers to represent a precocious stage of development of the Carditidæ, Astartidæ and Crassatellitidæ. They have an internal resilium, and a

striking feature is the near approach to symmetry of the early teeth with respect to the resilium. These small shells are also remarkable in the evidence they afford of the acceleration and retardation of certain characters relative to the time of appearance of such characters in allied groups. Another paper of more than ordinary interest* is on the Anatomy of *Chlamydoconcha oreutti*, a remarkable Californian bivalve, in which the valves are wholly internal and the adductor muscles so reduced that no trace of them remains. The work of M. Bernard in the main confirms the synopsis of characters given by the writer in 1884, exception being made of the anterior orifice of the mantle which proves to open into a *cul de sac* and may represent the point where the final immersion of the valves came to completion. A multitude of details are added to our knowledge of the animal and illustrated in the excellent manner usual with this author. The conclusion is that this mollusk represents the last term in a developmental series, of which *Galeomma* represents an early stage.

In a third paper† M. Bernard describes some interesting new forms, minute bivalves from New Zealand, belonging to the new genera *Pachykellya*, *Cyamiomactra* and *Perrierina*, with others belonging to *Neolepton*. All these are distinguished by marked peculiarities of the armature of the hinge, which are worked out with extreme care. These papers lead us to anticipate with the greatest interest the general work on the hinges of bivalves which M. Bernard has announced as in preparation.

Some years ago Carpenter described a curious little shell from Cape St. Lucas, which he named *Philobrya*, which appeared to be related to the pearl oysters. After-

* Bergen's Museums Aarbog for 1896, pp. 1-51, Pl. I.-IV., 1897.

† Op. cit., Art. X., pp. 32., with one plate.

‡ No. 3, pp. 169-206, 1897, with one plate.

* Ann. Sci. Nat. Zool. Ser. VIII., Vol. IV., pp. 321-252, Pl. 1, 1897.

† Extr. Bull. Mus. d'Hist. Nat. Paris, No. 7, pp. 309-314, 1897.

ward Vélain described another related shell from the islands of St. Paul and Amsterdam, under the name of *Hochstetteria*; and still more recently the writer made known another species of *Philobrya*, dredged by the Albatross on the Argentine coast, and called attention to the fact that the nepionic shell in this genus presented the characters of the *Glochidium* stage of the Unionidæ, and suggested that in *Philobrya* also this might correspond to an encysted parasitic stage. In an excellent paper on *Philobrya* and *Hochstetteria*, Bernard has added greatly to our knowledge, showing that the *Glochidium* in these genera represents a more advanced stage of development, including the presence of a provinculum, absent in the Unionidæ, and that the peculiarities of the shell are probably correlated with a large vitellus in the egg, rather than with any state of parasitic incubation. The soft parts in *Philobrya*, before the dissoconch is developed, have already passed the larval stage. These curious little shells, according to Bernard,* represent an early stage, not so much of any particular genus of Pteriidæ as of the group in general. It is certain, however, that the possession of a glochidial shell by both Unionidæ and the present group is a common character of no little significance, notwithstanding the fact that the inauguration of the dissoconch begins at slightly different stages in the two. Two systematic papers of unusual interest have recently appeared in the Transactions of the Connecticut Academy of Sciences. One by Professor Verrill† discusses the classification of the Pectinidæ, to which the author brings much erudition as well as a wide knowledge of the group. We believe that the subdivision of groups has been carried to an excessive minuteness, yet even this is preferable to the superficial study which slurs over points of difference with-

out consideration. In the second paper Miss Bush* discusses the minute gastropods generally referred to *Cylostrema*, *Adeorbis*, *Vitrinella* and related genera. She shows that an enormous amount of confusion has reigned among them and does much to clear it up, incidentally describing quite a number of new groups to which portions of the assembly are to be referred.

Dr. H. von Ihering, the director of the museum at San Paulo, Brazil, has followed in the steps of Burmeister in his energetic efforts to elucidate the natural history of his adopted country. In the second volume of the Revista do Museu Paulista, recently received, with his report for the year 1897, beside articles on plants, crustaceans, insects and fishes of Brazil, he has published a review of the Arcidæ and Mytilidæ of the Brazilian coast, an enumeration of the molluscan fauna of the Brazilian island of San Sebastian, and one, which is perhaps the most timely of all, on the Mollusks of the Patagonian Tertiary, mostly referable to what Hatcher has so recently shown to be horizons of Miocene age. These are well illustrated with seven very good plates and numerous figures in the text.

The leisurely manner in which scientific publication proceeds in France is well illustrated by two instances which have lately attracted attention. One is the announcement of the final fasciculus of the monumental work of Crosse and Fischer on the land and fresh-water mollusks of Mexico, which is a report of the authors on material collected during the ill-fated expedition of Maximilian more than thirty years ago. To this has been added much from other sources and valuable anatomical work, indispensable to all students of the subject, as well as a wealth of illustration of the highest quality. We can only lament that the junior author did not survive to see the completion of the publication.

* Op. cit., pp. 97-144, Pl. XXII.-XXIII., 1897.

* Journ. de Conchyl. Vol. 45, pp. 1-47, Pl. 1, 1897.

† Vol. X., pp. 41-96, Pl. XVI.-XXI., 1897.

The other case is that of the Report on the Mollusks of the deep-sea dredging expeditions sent out by France, 1880-83, in the *Travailleur* and *Talisman*. The first volume of this report by Arnould Locard,* on the Testaceous Mollusks, includes the Cephalopods, Pteropods and Gastropods as far as Litiopidæ. It is illustrated by excellent lithographic plates and is chiefly descriptive. A superficial examination gives the impression that the abyssal fauna of the eastern Atlantic does not materially differ in character from that of the American border of the same ocean, but that, so far as it does differ, it confirms the impression that the abyssal mollusk fauna of any coast is strongly tinctured with the faunal characteristics of the shallow waters of that coast; so that, while there are some ubiquitous or almost ubiquitous species and many ubiquitous genera, the deep-sea fauna will eventually be divisible into almost as many provinces as there are recognizable among the different faunas of the sea margin.

We congratulate the author on the appearance of this weighty instalment of his work, and desire to assure him that we also know what it is to publish through a government printing office.

WM. H. DALL.

ON THE LAW OF ANCESTRAL HEREDITY.†

THE Darwinian theory has for its main factor the perpetuation of favorable variations by natural selection under the law of heredity. Hence any complete quantitative treatment of evolution must deal: (1) with the nature and distribution of variation; (2) with the nature and influence of selection, and this not only upon the

* 4°, pp. iv + 516, Pl. I.-XXII.; Paris, Masson et Cie., 1897.

† 'Mathematical Contributions to the Theory of Evolution.' Abstract of a paper read before the Royal Society by Professor Karl Pearson, F.R.S., University College, London, January 27, 1898.

selected but upon all the correlated characters or organs; and (3) with the law of heredity. Earlier published and other written but unpublished papers of the present writer cover to some extent the ground of (1) and (2). Although the mathematical theory of variation and selection is yet very far from completion, the general lines on which it will proceed seem, to the present writer at any rate, fairly clear. With the law of heredity, however, the case has hitherto been different. Much has been written on the subject, much has been attributed to inheritance, but the quantitative measurements and facts have formed such a small and slender proportion of the whole that it has been extremely difficult to base a rounded mathematical theory on what is really known. It was with a view to the collection of further facts that the writer started his collection of Family Measurements, which would now have reached completion were it not that certain collateral relationships are still numerically somewhat deficient. Such facts are so all-important for real progress in our knowledge of heredity that the writer is convinced that there ought to be a comprehensive and systematic collection of them by some public body; the labor is beyond the powers of any unaided individual.

When the writer of the present paper wrote his memoir on Heredity, in 1895,* the only available material was contained in Mr. Francis Galton's *Natural Inheritance*, and in the data and measurements in Mr. Galton's hands, which he at once placed, with his usual generosity, at the writer's disposal. The very suggestive theory of heredity developed in the *Natural Inheritance* has two main features: (a) a theory of regression, which states the average proportion of any character which will be inherited under any degree of relationship. This theory was very simple; if the aver-

* *Phil. Trans.*, Vol. 187, A, p. 253.